Japanese Languriidæ, with Notes on their Habits and External Sexual Structure. By George Lewis, F.L.S.

[Read November 15, 1883.]

(Plate XIV.)

The first notice of Japanese Languriidæ appeared in the January number of the 'Entomologist's Monthly Magazine' in 1873; since then one species has been described by Von Harold in the M.T. Münch. ent. Verein. iii. p. 59, and during my late visit to Japan in 1880 and 1881 I obtained five new species, bringing the total up to 15, as under:—

Doubledaya bucculenta, n. sp.

Section I.

Languria ingens, n. sp.
—— pectoralis, *C. Waterh.*, ♀.
convexicollis, C. Waterh., ♂, nec Bohem. 1860, nec Horn. 1867.
sodalis, C. Waterh.
Waterhousei, Crotch.
—— nigritarsis, *C. Waterh.*
? *unicolor*, Motsch.
—— Lewisii, *Crotch.*
—— geniculata, *Harold.*
Languria nara, n. sp.
—— columella, n. sp.

Section II.

Languria atriceps, *Crotch.*
—— ruficeps, *Crotch.*
—— fucosa, n. sp.
—— prætermissa, *Janson.*

Section III.

Languria filiformis, *F.*
nigripes, Crotch.
—— præusta, *Crotch.*
Microlanguria Jansoni, *Crotch.*

Languria unicolor, Motsch., appears, with some doubt, as a synonym in the list; because, though it seems probable that Motschulsky's description was drawn from what is now either *nigritarsis* or *pectoralis*, his measurements are misprinted "$1\frac{1}{4}$ by 1 line:" for this and other reasons it would be but guesswork to apply his name to either of the species.

The highest point north of the equator in which any member of this family has been found is in latitude 46° in Siberia (*L. Menetriesi*); there are none in Europe, but I have a species from Egypt. In Japan three are found in lat. 43° and ten in lat. 33°; and as the climate in the south is evidently favourable to them, and some are local, we may still look for additions to the present list. If the Languriidæ do not certainly emanate from the tropics, it is clearly within an area of a thousand miles of the equator that they meet with the climatal environment which is most essential to their welfare and specific multiplication; and in this respect resemble somewhat the Brenthidæ, of which a few species also inhabit Japan. Of the few northern Languriidæ which overstep this line by 1200 miles, and to which these notes relate, comparative diminutiveness in size and sombreness in colour are the most striking characteristics; and the same may be said of the species of the United States, which reach as high as lat. 42° or 43°. We observe also that the Japanese species agree in facies and general outline with the forms in equinoctial Asia; and in the western hemisphere it is also true that the dominant types of the American continent are found south of Mexico. Harold has pointed out that *Languria nigripes*, Crotch, = *filiformis*, F.; and in the British Museum there are examples of the latter from Sumatra, Java, Luzon, and China; and of the little *Microlanguria Jansoni* I have specimens which I took at Colombo, one of the hottest places in the island of Ceylon. Here are two species therefore which are common both to Japan and to countries lying under, or close to, the equator. All this suggests a tropical origin as probable for these species, an hypothesis which may perhaps be extended also to their allies. *Languria præusta* probably occupies as wide an area of distribution as *L. nigripes*; I have myself taken it at Yokohama and in Hongkong, places distant from each other by an ocean-line of 1500 miles.

In the Munich Catalogue, 1876, there are only 114 species of Languriidæ given; and Harold, in the paper cited, describes in 1879 about 40 more; yet the total, say 160, can be but a small portion of those existing in nature, or even actually now extant in our collections. Harold merges *Pachylanguria*, *Tetralanguria*, *Fatua*, *Callilanguria* (allied to *Doubledaya*, figured here), and Crotch's other genera in *Languria*; and thus reduces the whole family to one genus, because it is at present an insufficiently studied group and requires revision. My own investigation leads me to accept Crotch's genera, and even to suggest one more. Crotch's *Languria Jansoni*, with "coarsely granulated eyes, elongate antennæ, 3-jointed club, and short tarsi," I have called *Microlanguria*. *Languria Mozardi*, Latr., from Texas, is the type of the genus *Languria*; and the points of dissimilarity between it and those in Section I. of this note, to which the Japanese *L. ingens* belongs, are more than sufficient to found a genus on, if the members of the group were numerous enough to render this desirable. I think also that *L. trifoliata*, Harold, may well be separated later, as it is one of a section having a peculiar form and structure, of which there are many species in Ceylon, the individuals of which, while usually clinging to foliage, are, when disturbed, instant in flight.

In the imago state some of the Languriidæ mount and cling to the stems and leaves of brushwood; others sit on the foliage of various biennials and perennials growing in the moist and half-shaded parts of forest; and some smaller species, often having blue elytra and a red thorax, frequent hillside débris, such as may be likened to haystack-refuse. Those on the low herbage may be swept off and obtained in abundance in the right localities; and the prevailing colour of the species of this habit is æneous or brassy green. This is all that was known about the habits of the Languriidæ until a notice appeared by Prof. J. H. Comstock in the Annual Report of the Department of Agriculture, Washington, 1879, where he traces the life-history of *Languria Mozardi* from the egg to the emergence of the imago. As his observations well deserve the notice of entomologists on this side of the Atlantic, I have thought it well to copy them *in extenso*:—

"In localities where this beetle is abundant, if the stems of red clover be carefully examined some time in June, on many of them will be seen one or more small discoloured spots, which seem to have been made by the gnawing of some insect. If one cuts into the stems at one of these spots, a slender yellowish egg 1·7 millim. (about $\frac{1}{16}$ inch) long, rounded at both ends, and somewhat curved, will be found imbedded in the pith, the gnawing having evidently been done for the purpose of penetrating the comparatively hard exterior and allowing the egg to be easily pushed in. Often the egg is found as far as 6 millim. (nearly $\frac{1}{4}$ inch) from the opening, which shows that the mother insect must have forced her whole body into it.

"The larvæ hatching from these eggs are slender, almost worm-like in form, and feed exclusively upon the pith of the stalk. While they do not kill the stem outright, they gradually weaken it, and eventually cause its destruction, having also, of course, a very injurious effect upon the maturing of the seed. The egg is usually laid high up in the stem, and the larva usually burrows downwards, often extending its work for a distance of from six to eight inches below the point of entrance. The full-grown larva is about 8 millim. ($\frac{3}{5}$ inch) in length, yellow in colour, with six prominent thoracic legs, and a prop-leg at the posterior end of the body. The last segment of the body has two stiff, slightly upward-curved spines above. Upon attaining full growth, the larva transforms to a pupa in the lower part of the burrow The pupa is about 6 millim. long, slender, with a large head, and is yellow in colour. The adult beetles begin to issue in August, and are continually making their exits until late in October.

"There is probably but one brood in a season, and the insect hybernates in the beetle state. An examination of many stalks during the winter failed to show the insect in any stage of growth."

Figures are given of the egg, larva, pupa, imago, and the stem of the clover with the larva feeding in it.

It seems obvious from this notice that the mode of life during the larval state connects the family rather with the Chrysomelidæ than with either the Erotylidæ or the Endomychidæ; and I must confess that my own observations of their general habits in Eastern Asia, where I almost daily saw examples of the commoner kinds, led me to place them near the Endomychidæ. Prof. Comstock's remark that "the larva usually burrows *downwards*, often extending its work for a distance of from six to eight inches below the point of entrance," shows it to be an internal feeder on living vegetation. If it ascended the stem above the orifice, it might be open to suggestion that a fungoid growth (on which Languriidæ have been supposed to feed) had commenced in the dead clover-stem; but this is clearly not the case. Prof. Comstock's observations also show us the reason of the parallel and unexceptional elongate form of the Languriidæ, in so far as we see this form is suited to the position of the imago before its egress from the hollow stem in which it has attained to maturity.

I think we must, after reading Prof. Comstock's paper, look at the Languriidæ as a, comparatively speaking, recent type of Coleoptera, nearer to the Chrysomelidæ than to the Erotylidæ, which has greatly multiplied its species, but which has, as yet, owing to simple and constant habits, been evolved in the direction of growth of the longitudinal axis only.

In the large families of Coleoptera, *e. g.* Carabidæ, we have convex and ovate forms, as *Omophron*, elongate figures in *Casnonia* and *Scarites*, and flat mouldings in *Morio*. Histeridæ have shapes corresponding to the above in *Saprinus*, *Tryponæus*, and *Dimalus* or *Hololepta*. Again, in the Chrysomelidæ, *Gastrolina* is a flat species which hybernates under *Planera*-bark, and convex and linear species of the group are familiar to all. It is only natural to look upon these forms in all the large sections of Coleoptera as the result of the complex agencies which must arise in, and are inseparable from, compound evolution. But in the opening life of a young group greater simplicity is, on the other hand, equally to be expected. Where we observe great diversity of form, there we see equal diversity of habit, as in the Carabidæ and Histeridæ; but at present we see neither one nor the other in the Languriidæ.

In a *Cucujus* the larva and pupa are flat, like the imago; the first and second stages are entirely passed under bark, and the third stage also in the greatest part. In *Gastrolina* above noted, a genus which stands next to *Chrysomela*, the larvæ and pupæ are of the ordinary gibbous form of the family, and feed on, in the first stage, and are suspended to, in the second, walnut-leaves. It is not until the imago appears that the insect is *flat*, and in condition to join the *Cucujus* and winter under the bark of the *Planera*. Even a gravid female could not hybernate under the close-fitting bark; but copulation takes place on the fresh foliage of spring after hybernation. Here is a singular fitting of a species for special environment during one stage; but it is only conspicuous to a Coleopterist, because it is unusual in the leaf-eating family of Chrysomelidæ. The phenomenon, however, prevails throughout the whole of the Lepidoptera and other orders, but, being general in them, attracts less attention.

As far as the Languriidæ are concerned, we can believe that, if they are all reared within a stem, or any enclosure of like capacity, as Prof. Comstock's observations may lead us to suppose probable, it will account for their acquiring the elongate form, which is at present the only form known to us in the family, and of their retaining it. If they should eventually prove, as a group, to be so constantly and invariably elongate as our museums, with slight exceptions, at present exhibit them, they must be either a recent divergence and undifferentiated, or the elongate form, when once acquired, answers the requirements of the insect's life better than any other shape, and has been acquired in a fairly simple life, which form inactivity and sluggishness of habit has confirmed rather than modified.

In the Heteromera there are analogous forms, both to the Languriidæ (*Dolichoderus* is like *Fatua*) and to the Erotylidæ (*Acropteron*), and this is the case in many other groups; so that we cannot say that there is any special modification in any one of these families beyond what their mode of life and its environment would lead us to expect. By analogous forms I mean forms agreeing in facies, with an approximate structure of appendages, these correspondences being evidently connected with the habits and surroundings of the species, and primarily caused by the conditions under which they exist. In the *Languria trifoliata*, Harold, already referred to, we have an outline which is, for this group, very considerably modified—" elytris post basin subampliatis," with the apex opening or dehiscent. This insect is so quick on the wing that it is difficult to capture.. Here is a difference in habit accompanied by a corresponding deviation of form, and evidently in some way correlative.

It cannot be said that the fashioning of the Languriidæ is the result of influences affecting the insect in some early stage (as larva or pupa) before the imago appears, because we see throughout the whole of the insect world that in each stage of an insect forms are assumed which are adapted solely to such stage, and are entirely free and uncontrolled by any external structure of the individual during any antecedent stage of its existence. Each, as a larva or imago, is formed for its environment to crawl or fly, and a process, which is not immediately obvious, checks in all its stages variation or an abrupt departure from the type of its predecessor.

I say acquiring and *retaining* their form, because, owing to the continuity of action in all natural forces which produce a permanent effect on the structure and composition of any animal, we cannot separate the creative from the preservative process.

A reference to a certain phase in the Vegetable Kingdom will illustrate my meaning. I take an Oak as the ordinary type of growth in a plant under normal conditions. In a full-grown tree the greatest circumference is in the part just above the root, the part which is half in, half out of the ground. This part represents the first growth in the acorn, which maintains a proportional bulk throughout the lifetime of the tree. The growth of vegetation in England is checked in autumn by the falling temperature, and the circulation in the tissue of a tree is stopped in all its parts (in a climate where growth is slow) almost at once. But let me picture an area nearer the tropics, such as many travellers have seen, in which during part of the year copious rain falls, and is then abruptly followed by a lengthened period of drought. With the drought the temperature rises, the sun and wind scorch the foliage and upper parts of the tree or plant, while a porous soil below drains the roots. The thick part of the tree or palm still retains a certain moisture, and, stimulated by the heat, continues to grow. An environment of this kind would cause a proneness to enlargement above the roots in many vegetables existing within its area; and as long as these conditions were fulfilled, this phenomenon would be a noticeable feature in the landscape. What I have roughly delineated here is a process which is, I believe, the origin of the bulbous forms of vegetation, whether it be that of a hyacinth, an onion, or a stunted oak. But who would doubt that, if the climate of this area changed, became, as it were, more like Ceylon, with continuous rain, this bulbiform habit which I have depicted would disappear, and in time be eradicated altogether by the plants resuming a more constant and uniform activity in all their parts. The dryness of this area at one period of the year is the illustration of the "creative" and "preservative" cause I wish to notice. The periodical dryness after luxuriant rain which originated the bulbous habit must continue to recur, otherwise it disappears. A small *Scilla* on Wimbledon Common is subject to these dry conditions as I describe in August; and in Japan, the home of the Liliaceæ, there is a long dry winter season (Ent. Mon. Mag. xviii. pp. 5–7), which has a great effect there on both animal and vegetable life.

The above illustration may serve to show what "reversion," commonly so called, is to my mind. All ideas of reversion appear to me to be greatly at variance with the doctrine of evolution. But let us suppose that an actual Ceylonese climate takes possession of the area spoken of. What happens? The plants would resume their growth, as I have suggested, in all their parts, and their globosity would disappear. Yet we could not call this reversion; for in reality there is no retrograde movement, although the second condition of these plants may be more like those forms from which they originally arose, or are supposed to be derived.

Sometimes entomologists, when they observe a succession of likenesses, such as those here traced in plants, in animals widely separated from each other in a system of classification, set the phenomenon down as originating through "natural selection" producing a resemblance which is supposed to be "protective," forgetting the while that like causes produce like effects, and cannot in this material world of ours act otherwise.

The process I have spoken of as checking variation appears to me to be akin to that enunciated by Spencer as "organic polarity" in his Chapter on "Waste and Repair;" and it is to this process I also think can be traced the manifestations which are usually regarded as phenomena of heredity. For if we say a certain family of plants (Begoniaceæ) possesses a certain polarity, we cannot refuse to admit that each species within that family has its own peculiar polarity. A step further leads us to say that each individual of a species has its individual polarity; and it is these individual distinctions or peculiarities, which we observe in organisms of the closest affinity, that are called phenomena of heredity. I think it would be as wrong to say that "organic polarity" was inherited as it would be to say that alum in water inherited a form of crystallization.

The new species are, as I have said, five in number; but I have added some remarks on others, in the order of the list, which the observation of external sexual characters renders necessary.

DOUBLEDAYA, *White*,

is a genus allied to *Callilanguria*, Crotch, and possesses some of its characters. Antennæ about as long as the head and thorax; joints 1–7 nearly equal, 8–10 dilated, 11 subovate; eyes moderate, granulate, and rather prominent; thorax rather convex above, longitudinally impressed, immarginate in front; elytra parallel at sides, truncate at the apex, twice and a third longer than the head and thorax, with the apical fold padded beneath with a short whitish pubescence.

The following sexual characters were not noticed by White or Crotch:—

Male. Head wide, robust at the neck; cheeks angulated and swollen to receive mandibles; left side much larger than right. The growth of the head affects the position of the antennæ and the eyes, and forms a frontal disk for them; eyes smaller than in the female. Thorax subquadrate, rather broader than long; basal angles acute. Legs elongate and simple; anterior tarsi very amply dilated, posterior tarsi much less so, middle tarsi intermediate between the other two.

Female. Head moderate, not distorted neck narrowed, being rather less than the head at the region of the eyes; eyes, viewed from above, project clearly beyond the outline of the head; thorax one third longer than broad; legs one third longer than in male, with only slight variation in the dilatation of the tarsi, all approximate to those of the middle pair of legs in male.

Note. The thorax of the female is much longer than in the male, and a generic character is that the antennæ are about as long as the thorax. The female has therefore, what is unusual in Coleoptera, longer antennæ than the male; and there is apparently some correlation between the length of the thorax and that of the antennæ.

Mr. Bates possesses a species of this genus from Assam, and I have another from the Andaman Islands. The described species, *D. victor*, White, and *D. Whitii*, Crotch, are from Madras and Sumatra respectively.

DOUBLEDAYA BUCCULENTA, n. sp. (Plate XIV. figs. 1, 2, 3.)

Supra omnino obscuro-ænea vel nigro-picea, subnitida; antennis pedibusque nigris, thorace in medio profunde canaliculato, circa canaliculam fortiter punctato, angulis posterioribus acutis, elytris fortiter punctato-striatis, interstitiis perleviter corrugatis; subtus nigra, abdomine undique punctato. Long. 12 ad 19 mill. ♂ capite latere sinistro valde angulato (fig. 3), thorace subquadrato, tarsis anticis dilatatissimis. ♀ thorace latitudine longiore.

Obscure brassy green, or more rarely pitchy black; the head and thorax at the sides have a few fine irregular punctures. The thorax is canaliculate in the medial region, and this furrow is occupied by larger and deeper punctures; the posterior angles are acute, and rather more produced in the male than in the female.

The curious sexual characters traced here are uniform and generic. At first sight the enlargement of the left side of the head in the male looks like a monstrosity; but it is merely another instance of that asymmetry which has been observed in the mouth-organs of males of species in several families. One-sided prognathism occurs also in *Callilanguria* ♂, and in the British Isles there is one instance of it in *Agathidium rhinoceros*.

I obtained this species *in copulâ* in Idzu in May 1880 and the year following in Higo; it is not common, and my series consists of only twenty examples. The specimens were beaten off brushwood mixed with bamboo which overhung mountain rivulets in well-shaded forests. This and the two following species are never found far from water, and are most about during the wet season, when the climatal conditions in South Japan closely resemble those of a tropical atmosphere.

The thick pubescence or padding beneath the apical fold of the elytra would act, if necessary, to prevent water from entering the space between the elytra and abdomen; but my observations are too limited to allow me to do more than hint at the use of this structure. If the mandibles of the male are used for gnawing bamboo after the manner of *L. Mozardi* in clover, they would mechanically act like the parrot-beaked scissors of horticulturalists.

LANGURIA INGENS, n. sp. (Plate XIV. figs. 4 & 5.)

Elongata, supra ænea seu æneo-virida, nitida; capite thoraceque undique punctatis; elytris striato-punctatis, interstitiis minute coriaceis, corpore subtus cum pedibus æneo-nigro, segmentis abdominalibus rufis exceptis; antennis sensim ampliatis 8–11 subtransversis. ♂ femoribus anticis subtus obsoleto-serrato-dentatis. Long. 11 mill.

This species is the largest in the genus from Japan, and comes near to *L. pectoralis*. It is easily separated from it by its large size, broader head, colour beneath, and the general contour of the elytra. The anterior angles of the thorax are never pale, but concolorous with the upper surface. Elytra are widest at the humeral angle, and gradually lessen towards the apex: *L. pectoralis* has a more parallel outline, owing to the greater width before the apex. The canthus of the eye at the point nearest the neck thickens, and from above looks like an angulated tubercle, and seems to serve as a protection to the eye during the retractile movements of the head, and is perhaps caused by the friction which then takes place. It is easy to distinguish the sexes in *L. ingens* by the dilatation of the fore tarsi; but in *L. pectoralis* this sexual character is scarcely observable.

The localities of this species are Chiuzenji and Junsai: on perennials within a few yards of the lakes in these places. I took twenty-five specimens.

The type of LANGURIA PECTORALIS, C. Waterh. (fig. 6, ♂), is a female of *L. convexicollis*. In this and *L. ingens* the males have a series of small denticulations on the undersides of the femora; the middle and hind tibiæ are somewhat bent, and at the apex of each is a small well-defined process or tooth (fig. 5) on the inner side. The female has the middle and hind tibiæ simple, and the fore tibiæ are simple in both sexes.

I obtained about fifty specimens: the plain of Fujisan and Junsai are the chief localities.

Languria nigritarsis, C. Waterh., is very closely allied to *L. pectoralis*. The type is a male, with sexual characters as above, and it is still unique in my collection.

Languria Lewisii, Crotch, has the fore femora of the male very clearly denticulate (fig. 8); the middle and hind tibiæ are less so. The fore tibia, viewed from the front with an ordinary glass, appears regularly denticulated; but a detached thigh, under a high power, shows that the denticulations consist of two rows, and that the placement is by no means uniform. The tibiæ of the male have the apical process almost obsolete, and in this particular agree with the two following species.

It is a common species at Kobe and Nikko and in a few places in Higo.

Languria geniculata, *Harold*.

I transcribe for reference the author's diagnosis:—"Supra ænea, subtus rufa, metasterno abdominisque triangulis apicalibus ænescentibus, pedibus rufis, geniculis tarsisque fuscis, antennis sensim dilatatis fusco-rufis, articulis 4, ultimis fuscis. Long. 7 mill."

If I have determined this insect correctly, it comes very near to *L. Lewisii*; but the antennæ have the 7th and 8th joints less transverse. Of forty specimens only three have the legs coloured as Harold describes them, and his description does not give the sexual characters, which are the same as in *L. Lewisii*.

Kobe, Oyama, Kashiwagi are localities for it, and I saw it in great abundance in the forest behind the large temple at Nara in June.

Languria nara, n. sp.

Near Nara I obtained two males and two females of a *Languria*, which measure only 4½ mill. They are very parallel, with humeral angles scarcely prominent; and as there are no intermediate forms in my long series of *L. geniculata*, I give them a provisional name as above. I have several single examples which apparently belong to as many species, but I leave them over until more material is available.

Languria columella, n. sp. (Plate XIV. fig. 9.)

Elongata, perparallela, ænea, nitidissima, prothorace subquadrato; elytris subigneo-cupreis, margine basali juxta scutellum carinato; antennis nigris, brevibus, sensim amplificatis; pedibus piceo-æneis vel partim rufis. Subtus rufo-picea. Long. 7½ mill.

This very distinct species is sculptured like *L. Lewisii*, and probably belongs to the same section of the genus. At present I have only two examples, and these are apparently both females. The thorax is very parallel, and the same width in front as behind; the humeral angles are scarcely prominent, and much less so than in any other Japanese species. The antennæ are also shorter and more robust in proportion to their length: this is a well-marked character.

I obtained the specimens on 8th May, 1881, in the Government forests, at a considerable elevation above Hitoyoshi. This and the four preceding species sit on the leaves of perennials as described.

LANGURIA FUCOSA, n. sp. (Plate XIV. figs. 12–13.)

Elongata, subparallela; capite nigro; thorace rufo, margine anteriore in medio nigricante; elytris punctato-striatis, cyaneis; pedibus rufis, geniculis piceo-nigris; antennis articulis 1–3 rufis, 4 picea, 5–11 nigris, 7–11 evidenter transversis. Long. 5 ad 6 mill.

This species is very near *L. ruficeps* (figs. 10 & 11), but the head is pitchy black or black, the knee-joints are dark-coloured, and the 7th and 8th joints of the antennæ are clearly transverse, forming apparently a 4-jointed instead of a 3-jointed club. In a long series the larger size is very perceptible. Sometimes examples are red beneath, sometimes pitchy red, and in others the dark anterior margin of the thorax extends and forms a discoid spot.

I took this species at Nagasaki, Kawasaki, Fukui, and Kashiwagi, and it is by no means rare.

Languria prætermissa, Janson, is a very distinct species, and very local. I obtained only two in 1881, from the same glen, behind the temple on Maiyasan, from where the type example came. These measure fully 5 mill.

Mr. Crotch formerly considered that specimens I have from China, resembling *atriceps* and *ruficeps*, were really these species, but they are distinct. If I remember right, his examination of them was only casual.

With reference to the sexual characters mentioned in the preceding descriptions and notes, I may remark that if a male of the *ingens* group is placed over a female as though in the act of attempting coition, it will be seen that the denticulations and roughnesses on the undersides of the femora (fig. 8) scratch the surface of the elytra of the female; the elytra at this part are slightly corrugated, and the attrition thus caused must materially assist the movements of the male. The bent tibiæ with apical teeth (fig. 5) also aid the male at this time, when the legs would be in active motion backwards and forwards, and help to support it while gaining the necessary position. This is seen in two specimens I have gummed the one over the other; and we can also see from these specimens that were these modifications extended to the fore tibiæ, which are always simple, the structure would be of no practical value.

It is a matter of great significance to me that the parts in the appendages of the male most used—parts which in an inorganic substance would be most worn—are the parts where additional tissue centres and forms additional structures, because it is a striking instance of the uniform action of nature, creating in the tibiæ of the Languriidæ parallel modifications to the enlarged muscles of the blacksmith, or the armature of the *Coprophaga* and other insects. The *Copris*, in boring its holes, would wear away its horn, if the increment of tissue did not tend to enlarge and build up that part. If it is said that any individual modification in the parent during, or close on, the act of congress would influence the offspring but little, as the elements of the future animal must then be in a state when modification is almost impossible, still, I think, that little is enough to be a great factor in time. And I would call to mind the fact that in all insects the time of sexual excitement is the time of the greatest physical effort and bodily exertion, and that even in the shortest-lived animals these efforts are continually made without affecting the female, as when possession is attempted by two males. This exercise is also observed sometimes (when the female is absent) between two males. We may be sure that it is when an insect is most active that modification of parts proceeds most rapidly, rather than in the passive time of hybernation or in the quietude of rest; for inert animals, such as Starfish, which live in water of considerable depth, where the temperature and general environment remain for long periods without change, can be traced, almost in their present form, back into geological times. Any modification, too, arising during hybernation would be more likely to be a chemical than a physiological change, and we could not conceive any reason for such modifications which might thus arise being useful to, or in accordance with, the habits of the species.

In all the species of the *ingens* section there is another notable sexual character—the thorax in the male is of much greater convexity than in the female. This development appears to be such as Dr. Leuthner has noticed in certain Lucanidæ, for the purpose of providing the necessary space for storing the muscles, which have enlarged gradually from the energy of the fore legs during the exercise of the functions I have referred to. In *Doubledaya* the thorax has a longitudinal furrow down its centre; and it is therefore probable that the muscles of the legs only occupy the spaces on each side of this groove; or, if the muscles meet in the centre, and form a compact mass, the chitinous covering is drawn down upon them.

In conclusion, let me add a word on the tarsal development of *Doubledaya*, as it appears to be different in some respects to the ordinary sexual dilatation in the Coleoptera. It is in fact only partially sexual. It is in part such as we find in *Carabus* ♂, and part such as we see in both sexes in *Chrysomela*; in the first as being in a degree sexual, in the second as being suited for clinging to foliage. Some of us have seen *Timarcha* on footpaths and herbage in spring and early summer, and noticed the slow drawly movements of the legs. The tibiæ are lifted well off the ground and passed forward in a perpendicular position, then let down, and after that there is another movement. This is a movement of the tarsus by which it becomes firmly attached to the leaf; and this is independent of, and subsequent to, the movement of the legs. This is the action or *use* which, to my mind, gives the breadth to the tarsi of Chrysomelidæ, causing three joints to dilate and absorb tissue at the expense of two others which become obsolete. In *Doubledaya* there is the *Chrysomela*-form of tarsus, existing in both sexes, and an extra breadth in the male, as in *Carabus*. The extra breadth enables the male to cling to the foliage when seated over the female, as specimens placed in this position show; and here also the utility of the shorter legs in the male becomes evident. In *Carabus* there is not this double function in the dilated tarsi, but there is in some of the smaller genera of the Carabidæ. In *Callida* and other foliage-species all the tarsi are fairly ample, and of nearly the same breath. In *Carabus* and *Pterostichus*, where great dilatation is observable, and confined to the fore tarsi, the species copulate in open spaces, and the fore tarsi are then used, as I believe, to arrest the progress of the female, which at this time would be in great activity. But in such genera as *Scarites* and *Morio*, and the innumerable allies of both, which copulate in burrows or under bark, that is in confined recesses from which the female cannot well escape, we see nothing but simple unmodified tarsi.

On these data it seems right to say that the males of *Doubledaya* have tarsi developed on the combined principle of *Carabus* and *Chrysomela*, and that this development is caused by the combination of those influences which act separately in the two last-named genera.

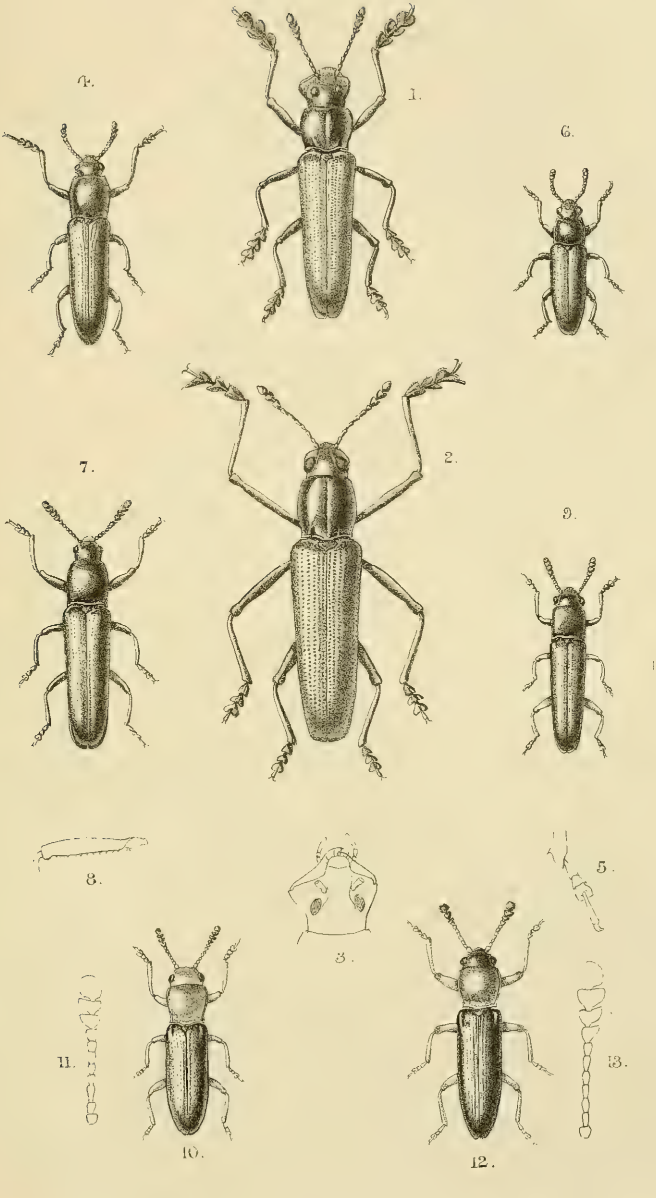
DESCRIPTION OF PLATE XIV.

Fig. 1. *Doubledaya bucculenta*, Lewis, male.
2. —— ——, female.
3. —— ——, male, head, magnified.
4. *Languria ingens*, Lewis, male.
5. —— ——, male, middle tibia, magnified.
6. —— *pectoralis*, C. Waterhouse, male.
7. —— *Lewisii*, Crotch, male.
8. —— ——, male, fore femur, magnified.
9. —— *columella*, Lewis.
10. —— *ruficeps*, Crotch.
11. —— ——, antenna, magnified.
12. —— *fucosa*, Lewis.
13. —— ——, antenna, magnified.

On the Replacement of a true Theca or Wall by Epitheca in some Serial Coralla, and on the Importance of the Structure in the Growth of Incrusting Corals. By Prof. P. Martin Duncan, F.R.S., Vice-Pres. Linn. Soc.

[Read November 15, 1883.]

During the discussions regarding the physiological value of some of the structures of Madreporaria, great discrepancies have been noticed in the opinions of naturalists. Amongst the structures which have been carefully considered, no one has been more debated than the epitheca. It has been pronounced to be worthless in generic diagnosis on account of its not being of primary



E. Wilson, del. et lith.

JAPANESE LANGURIIDÆ

Mintern Bros. imp.